What is claimed is:

1. A process for making 9-deoxy-PGF₁-type compounds comprising cyclizing a starting compound of the formula:

$$\begin{array}{c|c} & & & \\ & & & \\ \hline \\ & & & \\$$

into a compound of the following formula:

wherein Y₁ is trans-CH=CH-, cis-CH=CH-, -CH2(CH2)m-, or -C≡C-; m is 1,2, or 3; wherein R₁ is H or an alcohol protecting group; wherein R₁ is

- (1) -C_pH_{2p}-CH₃, wherein p is an integer from 1 to 5, inclusive,
- (2) phenoxy optionally substituted by one, two or three chloro, fluoro, trifluoromethyl, (C₁-C₃)alkyl, or (C₁-C₃)alkoxy, with the proviso that not more than two substituents are other than alkyl, with the proviso that R₇ is phenoxy or substituted phenoxy, only when R₃ and R₄ are hydrogen or methyl, being the same or different,
- (3) phenyl, benzyl, phenylethyl, or phenylpropyl optionally substituted on the aromatic ring by one, two or three chloro, fluoro, trifluoromethyl, (C₁-C₃)alkyl, or (C₁-C₃)alkoxy, with the proviso that not more than two substituents are other than alkyl,
 - (4) $cis-CH=CH-CH_2-CH_3$,
 - (5) - $(CH_2)_2$ -CH(OH)- CH_3 , or
 - (6) $-(CH_2)_3-CH=C(CH_3)_2$;

wherein -C(L₁)-R₇ taken together is

- (1) (C₄-C₇)cycloalkyl optionally substituted by 1 to 3 (C₁-C₅) alkyl;
- (2) 2-(2-furyl)ethyl,
- (3) 2-(3-thienyl)ethoxy, or
- (4) 3-thienyloxymethyl;

wherein M_1 is α -OH: β -R₅ or α -R₅: β -OH or α -OR₁: β -R₅ or α -R₅: β -OR₁, wherein R₅ is hydrogen or methyl and R₁ is an alcohol protecting group; and

wherein L_1 is α - R_3 : β - R_4 , α - R_4 : β - R_3 , or a mixture of α - R_3 : β - R_4 and α - R_4 : β - R_3 , wherein R_3 and R_4 are hydrogen, methyl, or fluoro, being the same or different, with the proviso that one of R_3 and R_4 is fluoro only when the other is hydrogen or fluoro.

- 2. The process as claimed in claim 1, wherein the cyclization is a cobalt-mediated cyclization.
- 3. The process as claimed in claim 2, wherein the starting compound is reacted with $Co_2(CO)_8$ in a non-reactive solvent to form a complex.
- 4. The process as claimed in claim 3, wherein the non-reactive solvent during the complex-forming step is 1,2-DME.
- 5. A stereoselective process of making a 9-deoxy-PGF₁-type compound, comprising the following reaction:

wherein R₁ is an alcohol protecting group;

wherein n is 0, 1, 2, or 3;

wherein Y_1 is trans-CH=CH-, cis-CH=CH-, -CH₂(CH₂)_m-, or -C=C-; m is 1, 2, or 3;

wherein R7 is

(1) -C_pH_{2p}-CH₃, wherein p is an integer from 1 to 5, inclusive,

- (2) phenoxy optionally substituted by one, two or three chloro, fluoro, trifluoromethyl, (C₁-C₃)alkyl, or (C₁-C₃)alkoxy, with the proviso that not more than two substituents are other than alkyl, with the proviso that R₇ is phenoxy or substituted phenoxy, only when R₃ and R₄ are hydrogen or methyl, being the same or different,
- (3) phenyl, benzyl, phenylethyl, or phenylpropyl optionally substituted on the aromatic ring by one, two or three chloro, fluoro, trifluoromethyl, (C₁-C₃)alkyl, or (C₁-C₃)alkoxy, with the proviso that not more than two substituents are other than alkyl,
 - (4) $cis-CH=CH-CH_2-CH_3$,
 - (5) -(CH₂)₂-CH(OH)-CH₃, or
 - (6) $-(CH_2)_3-CH=C(CH_3)_2$;

wherein $-C(L_1)-R_7$ taken together is

- (1) (C₄-C₇)cycloalkyl optionally substituted by 1 to 3 (C₁-C₅) alkyl;
- (2) 2-(2-furyl)ethyl,
- (3) 2-(3-thienyl)ethoxy, or
- (4) 3-thienyloxymethyl;

wherein M_1 is α -OH: β -R₅ or α -R₅: β -OH or α -OR₁: β -R₅ or α -R₅: β -OR₁, wherein R₅ is hydrogen or methyl and R₁ is an alcohol protecting group;

wherein L_1 is α -R₃: β -R₄, α -R₄: β -R₃, or a mixture of α -R₃: β -R₄ and α -R₄: β -R₃, wherein R₃ and R₄ are hydrogen, methyl, or fluoro, being the same or different, with the proviso that one of R₃ and R₄ is fluoro only when the other is hydrogen or fluoro.

(R)-2-Methyl-CBS-oxazaborolidine

6. The process as claimed in claim 1, further comprising the following steps:

7. The process as claimed in claim 6, comprising the following steps:

wherein m is 1, 2, or 3.

- 8. The process as claimed in claim 7, wherein m is 1.
- 9. A compound of the formula:

wherein Y_1 is trans-CH=CH-, cis-CH=CH-, -CH₂(CH₂)_m-, or -C=C-; m is 1,2, or 3;

wherein R7 is

- (1) -C_pH_{2p}-CH₃, wherein p is an integer from 1 to 5, inclusive,
- (2) phenoxy optionally substituted by one, two or three chloro, fluoro, trifluoromethyl, (C₁-C₃)alkyl, or (C₁-C₃)alkoxy, with the proviso that not more than two substituents are other than alkyl, with the proviso that R₇ is phenoxy or substituted phenoxy, only when R₃ and R₄ are hydrogen or methyl, being the same or different,
- (3) phenyl, benzyl, phenylethyl, or phenylpropyl optionally substituted on the aromatic ring by one, two or three chloro, fluoro, trifluoromethyl, (C₁-C₃)alkyl, or (C₁-C₃)alkoxy, with the proviso that not more than two substituents are other than alkyl,
 - (4) $cis-CH=CH-CH_2-CH_3$,
 - (5) $-(CH_2)_2-CH(OH)-CH_3$, or
 - (6) $-(CH_2)_3-CH=C(CH_3)_2$;

wherein $-C(L_1)-R_7$ taken together is

- (1) (C₄-C₇)cycloalkyl optionally substituted by 1 to 3 (C₁-C₅) alkyl;
- (2) 2-(2-furyl)ethyl,
- (3) 2-(3-thienyl)ethoxy, or
- (4) 3-thienyloxymethyl;

wherein M_1 is α -OH: β -R₅ or α -R₅: β -OH or α -OR₁: β -R₅ or α -R₅: β -OR₁, wherein R₅ is hydrogen or methyl and R₁ is an alcohol protecting group;

wherein L_1 is α - R_3 : β - R_4 , α - R_4 : β - R_3 , or a mixture of α - R_3 : β - R_4 and α - R_4 : β - R_3 , wherein R_3 and R_4 are hydrogen, methyl, or fluoro, being the same or different, with the proviso that one of R_3 and R_4 is fluoro only when the other is hydrogen or fluoro.

10. A compound of the formula:

$$\begin{array}{c|c} & & & \\ \hline \\ & & \\ \hline \\ OBn \end{array}$$

wherein Y₁ is trans-CH=CH-, cis-CH=CH-, -CH₂(CH₂)_m-, or -C \equiv C-; m is 1,2, or 3;

wherein R7 is

- (1) -C_pH_{2p}-CH₃, wherein p is an integer from 1 to 5, inclusive,
- (2) phenoxy optionally substituted by one, two or three chloro, fluoro, trifluoromethyl, (C₁-C₃)alkyl, or (C₁-C₃)alkoxy, with the proviso that not more than two substituents are other than alkyl, with the proviso that R₇ is phenoxy or substituted phenoxy, only when R₃ and R₄ are hydrogen or methyl, being the same or different,
- (3) phenyl, benzyl, phenylethyl, or phenylpropyl optionally substituted on the aromatic ring by one, two or three chloro, fluoro, trifluoromethyl, (C₁-C₃)alkyl, or (C₁-C₃)alkoxy, with the proviso that not more than two substituents are other than alkyl.
 - (4) $cis-CH=CH-CH_2-CH_3$,
 - (5) -(CH₂)₂-CH(OH)-CH₃, or
 - (6) $-(CH_2)_3-CH=C(CH_3)_2$;

wherein -C(L₁)-R₇ taken together is

- (1) (C₄-C₇)cycloalkyl optionally substituted by 1 to 3 (C₁-C₅) alkyl;
- (2) 2-(2-furyl)ethyl,
- (3) 2-(3-thienyl)ethoxy, or
- (4) 3-thienyloxymethyl;

wherein M₁ is α -OH: β -R₅ or α -R₅: β -OH or α -OR₁: β -R₅ or α -R₅: β -OR₁, wherein R₅ is hydrogen or methyl and R₁ is an alcohol protecting group;

wherein L_1 is α -R₃: β -R₄, α -R₄: β -R₃, or a mixture of α -R₃: β -R₄ and α -R₄: β -R₃, wherein R₃ and R₄ are hydrogen, methyl, or fluoro, being the same or different, with the proviso that one of R₃ and R₄ is fluoro only when the other is hydrogen or fluoro.

11. A compound of the formula

$$\begin{array}{c|c} & & & \\ & & & \\ \hline \\ & & & \\$$

wherein Y_1 is trans-CH=CH-, cis-CH=CH-, -CH₂(CH₂)_m-, or -C=C-; m is 1,2, or 3;

wherein R7 is

- (1) -C_pH_{2p}-CH₃, wherein p is an integer from 1 to 5, inclusive,
- (2) phenoxy optionally substituted by one, two or three chloro, fluoro, trifluoromethyl, (C₁-C₃)alkyl, or (C₁-C₃)alkoxy, with the proviso that not more than two substituents are other than alkyl, with the proviso that R₇ is phenoxy or substituted phenoxy, only when R₃ and R₄ are hydrogen or methyl, being the same or different,
- (3) phenyl, benzyl, phenylethyl, or phenylpropyl optionally substituted on the aromatic ring by one, two or three chloro, fluoro, trifluoromethyl, (C₁-C₃)alkyl, or (C₁-C₃)alkoxy, with the proviso that not more than two substituents are other than alkyl,
 - (4) $cis-CH=CH-CH_2-CH_3$,
 - (5) $-(CH_2)_2-CH(OH)-CH_3$, or
 - (6) $-(CH_2)_3-CH=C(CH_3)_2$;

wherein -C(L₁)-R₇ taken together is

- (1) (C₄-C₇)cycloalkyl optionally substituted by 1 to 3 (C₁-C₅) alkyl;
- (2) 2-(2-furyl)ethyl,
- (3) 2-(3-thienyl)ethoxy, or
- (4) 3-thienyloxymethyl;

wherein M_1 is α -OH: β -Rs or α -Rs: β -OH or α -OR1: β -Rs or α -Rs: β -OR1, wherein Rs is hydrogen or methyl and R1 is an alcohol protecting group;

wherein L_1 is α - R_3 : β - R_4 , α - R_4 : β - R_3 , or a mixture of α - R_3 : β - R_4 and α - R_4 : β - R_3 , wherein R_3 and R_4 are hydrogen, methyl, or fluoro, being the same or different, with the proviso that one of R_3 and R_4 is fluoro only when the other is hydrogen or fluoro.

12. A compound of the formula

$$C$$
 C
 C
 C
 C
 M_1
 C
 M_1
 C
 M_1
 M_2
 M_3
 M_4
 M_1
 M_1
 M_2
 M_3
 M_4
 M_4

wherein R1 is an alcohol protecting group;

wherein Y_1 is trans-CH=CH-, cis-CH=CH-, -CH₂(CH₂)_m-, or -C=C-; m is 1,2, or

wherein R7 is

3;

- (1) -C_pH_{2p}-CH₃, wherein p is an integer from 1 to 5, inclusive.
- (2) phenoxy optionally substituted by one, two or three chloro, fluoro, trifluoromethyl, (C₁-C₃)alkyl, or (C₁-C₃)alkoxy, with the proviso that not more than two substituents are other than alkyl, with the proviso that R₇ is phenoxy or substituted phenoxy, only when R₃ and R₄ are hydrogen or methyl, being the same or different,
- (3) phenyl, benzyl, phenylethyl, or phenylpropyl optionally substituted on the aromatic ring by one, two or three chloro, fluoro, trifluoromethyl, (C₁-C₃)alkyl, or (C₁-C₃)alkoxy, with the proviso that not more than two substituents are other than alkyl,
 - (4) $cis-CH=CH-CH_2-CH_3$,
 - (5) -(CH₂)₂-CH(OH)-CH₃, or
 - (6) $-(CH_2)_3-CH=C(CH_3)_2$;

wherein $-C(L_1)-R_7$ taken together is

- (1) (C₄-C₇)cycloalkyl optionally substituted by 1 to 3 (C₁-C₅) alkyl;
- (2) 2-(2-furyl)ethyl,
- (3) 2-(3-thienyl)ethoxy, or
- (4) 3-thienyloxymethyl:

wherein M_1 is α -OH: β -Rs or α -Rs: β -OH or α -OR1: β -Rs or α -Rs: β -OR1, wherein Rs is hydrogen or methyl and R1 is an alcohol protecting group;

wherein L_1 is α - R_3 : β - R_4 , α - R_4 : β - R_3 , or a mixture of α - R_3 : β - R_4 and α - R_4 : β - R_3 , wherein R_3 and R_4 are hydrogen, methyl, or fluoro, being the same or different, with the proviso that one of R_3 and R_4 is fluoro only when the other is hydrogen or fluoro.

13. A compound of the formula

$$\begin{array}{c|c} OR_1 & & \\ \hline \\ OB_1 & & \\ OB_1 & & \\ \hline \\ O$$

wherein R₁ is an alcohol protecting group;

wherein Y_1 is trans-CH=CH-, cis-CH=CH-, -CH₂(CH₂)_m-, or -C=C-; m is 1, 2, or 3;

wherein R7 is

- (1) -C_pH_{2p}-CH₃, wherein p is an integer from 1 to 5, inclusive,
- (2) phenoxy optionally substituted by one, two or three chloro, fluoro, trifluoromethyl, (C₁-C₃)alkyl, or (C₁-C₃)alkoxy, with the proviso that not more than two substituents are other than alkyl, with the proviso that R₇ is phenoxy or substituted phenoxy, only when R₃ and R₄ are hydrogen or methyl, being the same or different,
- (3) phenyl, benzyl, phenylethyl, or phenylpropyl optionally substituted on the aromatic ring by one, two or three chloro, fluoro, trifluoromethyl, (C₁-C₃)alkyl, or (C₁-C₃)alkoxy, with the proviso that not more than two substituents are other than alkyl,
 - (4) $cis-CH=CH-CH_2-CH_3$,
 - (5) -(CH₂)₂-CH(OH)-CH₃, or
 - (6) $-(CH_2)_3-CH=C(CH_3)_2$;

wherein $-C(L_1)-R_7$ taken together is

- (1) (C₄-C₇)cycloalkyl optionally substituted by 1 to 3 (C₁-C₅) alkyl;
- (2) 2-(2-furyl)ethyl,

- (3) 2-(3-thienyl)ethoxy, or
- (4) 3-thienyloxymethyl;

wherein M_1 is α -OH: β -R₅ or α -R₅: β -OH or α -OR₁: β -R₅ or α -R₅: β -OR₁, wherein R₅ is hydrogen or methyl and R₁ is an alcohol protecting group;

wherein L_1 is α - R_3 : β - R_4 , α - R_4 : β - R_3 , or a mixture of α - R_3 : β - R_4 and α - R_4 : β - R_3 , wherein R_3 and R_4 are hydrogen, methyl, or fluoro, being the same or different, with the proviso that one of R_3 and R_4 is fluoro only when the other is hydrogen or fluoro.

14. A stereoselectively produced isomeric compound according to the following formula:

$$\begin{array}{c|c} & & & \\ & & &$$

wherein Z, X, Y_1 , M_1 , L_1 , R_7 and n are as defined in claim 1 and said compound is produced according to the stereoselective synthesis of claim 1.

- 15. The stereoselectively produced isomeric compound of claim 14, wherein Z is O, n is 1, X is COOH, Y_1 is -CH₂CH₂- M_1 is α -OH: β -R₅, wherein R₃ is hydrogen, L_1 is α -R₃: β -R₄, wherein R₃ and R₄ are hydrogen and R₇ is propyl.
- 16. The stereoselectively produced compounds of claim 14, which are produced as pure diasteromers.